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Designing for Construction Ergonomics

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Abstract

Relative to other industries in South Africa and construction industries worldwide, the construction process generates a disproportionate number of fatalities, injuries and disease, and both the direct and indirect costs contribute to the cumulative cost of construction. Designers influence construction ergonomics directly and indirectly. The direct influence is as a result of design, details and method of fixing, and depending upon the type of procurement system, supervisory and administrative interventions. The indirect influence is as a result of the type of procurement system used, pre-qualification, project duration, partnering, and the facilitating of pre-planning. The purpose of the paper is to present the results of a study conducted among architectural technologists in South Africa using a self-administered questionnaire, to determine their perceptions and practices relative to construction ergonomics. Descriptive statistics in the form of frequencies and a measure of central tendency were computed from the collected data. The following constitute the salient findings. Cost, quality, and time are more important to architectural technologists than construction ergonomics and project health and safety (H&S). Ergonomics during the user phase is more important to architectural technologists than the other phases. A range of design related aspects impact on construction ergonomics. To a degree, construction ergonomics is considered on most design, procurement, and construction occasions by architectural technologists. Experience predominates in terms of the means by which ergonomics knowledge was acquired. A range of aspects have the potential to contribute to an improvement in knowledge and the application of construction ergonomics. The paper concludes that architectural technologists contribute to construction ergonomics, but that there is potential for and a clear need for enhanced contributions. Recommendations include the inclusion of construction ergonomics in architectural technologists' tertiary education, and continuing professional development (CPD), to remedy shortcomings in practitioners' knowledge.

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Keywords: construction; designers; ergonomics

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1. Introduction

The South African Construction Regulations [1] state that during the design stage, designers must take cognizance of ergonomic design principles in order to minimize ergonomic related hazards in all phases of the life cycle of a structure. This amplifies the need for 'designing for safety', which Behm [2] defines as "The consideration of construction site safety in the preparation of plans and specifications for construction projects."

Hecker et al. [3] contend that H&S through design is a fundamental principle of ergonomics. They further contend that architects and engineers regularly address ergonomics in their designs, but with a significant limitation, namely that the concerns apply almost exclusively to the end-user of a facility, rather than the workers who construct it. They also cite Behm who states that such an approach is problematical in that there is growing evidence that the design of permanent structures has a significant impact on risks to those who construct them.

Hecker and Gambatese [4] maintain 'H&S through design' is a familiar concept to occupational hygienists in that they invoke the primacy of 'engineering controls' in the hierarchy of controls that is fundamental to the process of hazard reduction. They further maintain that construction workers have previously received limited benefit from 'H&S through design', and although designers consider H&S in their designs it has been relative to the end user of the facility rather than the workers that construct it. Gambatese [5] emphatically states that historically, the design profession has not addressed construction H&S. Furthermore, he states that designers feel that they are not adequately educated or trained to address construction H&S, and they contend that they do not have the contractual authority to dictate site activities.

The paper reports on a study conducted among members of the South African Institute of Architectural Technologists (SAIAT), the objectives being to determine the:

- Importance of project parameters to architectural practices and contractors;
- Importance of ergonomics during the various project phases to architectural practices;
- Frequency at which architectural practices consider construction ergonomics on various occasions and relative to various design related aspects;
- Extent to which various design related aspects impact on construction ergonomics;
- Source of ergonomics knowledge;
- Potential of various aspects to contribute to an improvement in construction ergonomics, and
- Degree of awareness relative to certain provisions of the Occupational Health and Safety Act (OH&S Act) and the Construction Regulations.

2. Review of the literature

2.1 Legislation and recommendations pertaining to designers

The South African OH&S Act [6] schedules comprehensive requirements. Prior to the promulgation of the Construction Regulations all designers were required to address H&S, as in terms of Section 10 of the OH&S Act designers are allocated the responsibility to ensure that any 'article' is safe and without risks when properly used.

The Construction Regulations [1] lay down important requirements with respect to clients and designers. Clients are required to, inter alia: prepare a baseline risk assessment (BRA); prepare an H&S specification based on the BRA; provide the designer with the H&S specification; ensure that the designer takes the H&S specification into account during design; ensure that the designer carries out the duties in Regulation 6 'Duties of designers'; include the H&S specification in the tender documents; ensure that potential PCs have made provision for the cost of H&S in their tenders, and ensure that the PC to be appointed has the necessary competencies and resources.

Designers are required to, inter alia: ensure that the H&S standards incorporated into the regulations are complied with in the design; take the H&S specification into consideration; include in a report to the client before tender stage all relevant H&S information about the design that may affect the pricing of the work, the geotechnical-science aspects, and the loading that the structure is designed to withstand; inform the client of any known or anticipated dangers or hazards relating to the construction work, and make available all relevant information required for the safe execution of the work upon being designed or when the design is changed; modify the design or make use of substitute materials where the design necessitates the use of dangerous procedures or materials hazardous to H&S, and consider hazards relating to subsequent maintenance of the structure and make provision in the design for that work to be performed to minimize the risk.

Furthermore, the International Labour Office (ILO) [7] specifically states that designers should: receive training in H&S; integrate the H&S of construction workers into the design and planning process; not include anything in a design which would necessitate the use of dangerous structural or other procedures or hazardous materials which could be avoided by design modifications or by substitute materials, and take into account the H&S of workers during subsequent maintenance.

Thorpe [8] states that there is no more important stage in the construction process than that of design as at this stage conceptual ideas are converted into constructable realities. He further states that a variety of considerations need to be balanced simultaneously, inter alia, designing for safety. He highlights that designing for safety is an integral part of the wider design process and therefore needs to be included in design planning as doing so will result in safer construction and maintenance of structures and facilities. Files must be in MS Word only and should be formatted for direct printing, using the CRC MS Word provided. Figures and tables should be embedded and not supplied separately.

2.2 Impact of designers on construction ergonomics

Behm [2] analysed 450 reports of construction workers' deaths and disabling injuries in the USA to determine whether addressing H&S in the project designs could have prevented the incidents. The findings of this research determined that in 151 cases (33.6%), the hazard that contributed to the incident could have been eliminated or reduced if design-for-H&S measures had been implemented.

2.3 Obstacles to designing for construction ergonomics

Hecker et al. [3] cite the following as obstacles to designing for ergonomics: the narrow specialisation of design and construction practice; limited pre-construction collaboration between the designer and constructor due to the traditional construction procurement system (TCPS); the limited availability of ergonomics-in-design tools, guidelines and procedures, and the limited education architects and engineers receive regarding construction ergonomics.

2.4 Potential of designers to contribute to construction ergonomics

Spielholz and Chavez [9] report on a project which investigated construction specifications and the opportunity to mitigate problems upstream. An ergonomics professional and an architect / specifier compiled a list of hazards identified in a building specification and the solutions thereto. Draft language was developed for both a general H&S section and for insertion in the appropriate work sections. The resultant specifications include industry better practices, which in most cases result in improved quality and productivity, and reduce the risk of injury to construction and maintenance workers. Insertions include the: use of a powered-screed for screeding concrete; use of a mechanical trowel where the unbroken slab area is greater than 800 square-feet, use of powered wire pullers for long runs of electrical conduiting where feasible, and use of powered-stretchers for carpet stretching relative to carpet laying.

South African built environment practitioners surveyed during a construction ergonomics seminar indicated the extent to which aspects could contribute to an improvement in construction ergonomics [10]. The extent in terms of a mean score ranging between 1.00 and 5.00 is: constructability (general) (4.53); awareness (4.52); mechanisation (4.45); prefabrication (4.31); general design (4.22); reengineering (4.19); specification (4.09), and details (4.03).

2. Research method

The sample stratum consisted of 492 members of the South African Institute of Architectural Technologists (SAIAT). Eleven questionnaires were not delivered to addressees, and were returned to the sender, and one recipient's mother responded that her daughter was temporarily overseas. Furthermore, one of the 38 questionnaires returned in response to the postal survey was not included in the analysis of the data, as it was mostly incomplete. Therefore, the net response rate is 7.7% [37 / (492 – 12)].

The analysis of the data consisted of the calculation of descriptive statistics to depict the frequency distribution and central tendency of responses to fixed response questions.

4. Research findings

Table 1 indicates the importance of seven parameters in terms of percentage responses to a scale of 1 (not important) to 5 (very important), and a mean score (MS) ranging between 1.00 and 5.00. It is notable that the MSs are all above the midpoint of 3.00, which indicates that in general the respondents can be deemed to perceive the parameters as important. However, given that the MSs for the top five parameters are > 4.20 ≤ 5.00, the respondents can be deemed to perceive them to be between more than important to very important / very important. It is notable that only one of the three traditional project parameters, namely project quality, is ranked within the top three and then first. The other two, namely project cost and project time are ranked joint fourth. It is also notable that construction ergonomics, the subject of the study is ranked seventh – last. Furthermore, third ranked end-user ergonomics has a MS of 4.46, which is effectively 18.2% higher than the 3.92 MS of construction ergonomics.

Table 1. Importance of project parameters to Architectural Technologists.

Parameter	Response (%)						Mean Score	Rank
	Unsure	Not ……………..…………… Very						
		1	2	3	4	5		
Project quality	0.0	0.0	2.7	2.7	27.0	67.6	4.59	1
Environment	0.0	0.0	0.0	10.8	29.7	59.5	4.49	2
End-user ergonomics	2.7	0.0	0.0	2.7	35.1	59.5	4.46	3
Project time	0.0	0.0	2.7	13.5	27.0	56.8	4.38	4
Project cost	0.0	0.0	2.7	8.1	40.5	48.6	4.35	5
Project H&S	2.7	0.0	2.7	21.6	16.2	56.8	4.19	6
Construction ergonomics	0.0	0.0	10.8	24.3	27.0	37.8	3.92	7

Table 2 indicates the importance of ergonomics to architectural technologists during the various project phases in terms of percentage responses to a scale of 1 (not important) to 5 (very important), and a MS ranging between 1.00 and 5.00. It is notable that with the exception of deconstruction, the MSs are all above the midpoint of 3.00, which indicates that in general the respondents can be deemed to perceive ergonomics to be important during various project phases.

Use is the only phase that falls within the range > 4.20 ≤ 5.00 – between more than important to very important / very important. Maintenance, construction, and commissioning in turn fall within the range > 3.40 ≤ 4.20 – between important to more than important / more than important. Deconstruction in turn, falls within the range > 2.60 ≤ 3.40 – between less than important to important / important.

It is notable that the 4.46 MS of use is effectively 37.9% higher than that of commissioning, 32.1% higher than that of construction, and 9.4% higher than maintenance, which is the most common category of recycling of buildings.

Table 2. Degree of importance of ergonomics to Architectural Technologists during various building / structure phases.

Phase	Response (%)						Mean Score	Rank
	Unsure	Not……………………………………………………………..Very						
		1	2	3	4	5		
Use	2.7	0.0	2.7	8.1	16.2	70.3	4.46	1
Maintenance	2.9	2.9	0.0	14.3	31.4	48.6	4.14	2
Construction	2.7	2.7	10.8	24.3	32.4	27.0	3.62	3
Commissioning	5.4	0.0	21.6	16.2	32.4	24.3	3.43	4
Deconstruction	13.5	8.1	16.2	29.7	16.2	16.2	2.76	5

Table 3 presents the frequencies at which architectural technologists consider or refer to construction ergonomics on fourteen occasions in terms of a frequency range, never to always, and a MS ranging between 1.00 and 5.00. The project phase within which the occasion falls is referenced between parentheses in terms of stream: upstream; midstream, and downstream. It is notable that three (21.4%) of the fourteen MSs are above the midpoint of the range, namely 3.00, which indicates the consideration of or reference to construction ergonomics on these occasions can be deemed to be prevalent.

It is notable that no occasions fall within the range > 4.20 ≤ 5.00 – between often to always / always, and similarly within the range > 3.40 ≤ 4.20 – between sometimes to often / often. However, it is also notable that the top three occasions are all 'upstream' occasions, and that concept design, the occasion when construction ergonomics should be first considered, is ranked second. The top seven ranked occasions fall within the range > 2.60 ≤ 3.40 – between rarely to sometimes / sometimes, and those ranked seventh to joint twelfth fall within the range > 1.80 ≤ 2.60 – between never to rarely / rarely. Last ranked pre-tender meeting falls within the range > 1.00 ≤ 1.80 – between never to rarely.

Table 3. Frequency at which Architectural Technologists consider / refer to construction ergonomics on various occasions.

Occasion (Stream)	Response (%)						Mean Score	Rank
	Unsure	Never	Rarely	Some-times	Often	Always		
Working drawings (Up)	0.0	2.7	8.1	35.1	48.6	2.7	3.32	1
Detailed design (Up)	0.0	2.7	8.1	35.1	51.4	0.0	3.30	2
Concept design (Up)	0.0	5.4	0.0	45.9	43.2	2.7	3.30	3
Site inspections / discussions (Down)	0.0	5.4	16.2	48.6	21.6	2.7	2.84	4
Preparing project documentation (Mid)	2.7	5.4	32.4	27.0	32.4	0.0	2.81	5
Site meetings (Down)	0.0	5.4	32.4	37.8	18.9	2.7	2.73	6
Design coordination meetings (Up)	2.7	13.5	8.1	56.8	16.2	0.0	2.65	7
Client meetings (Up)	0.0	10.8	32.4	27.0	24.3	0.0	2.54	8
Constructability reviews (Up)	5.4	10.8	32.4	29.7	18.9	0.0	2.41	9
Site handover (Mid)	8.1	16.2	13.5	32.4	18.9	0.0	2.16	10
Pre-qualifying contractors (Mid)	10.8	8.1	27.0	27.0	13.5	0.0	1.97	11
Deliberating project duration (Up)	10.8	18.9	27.0	27.0	8.1	0.0	1.86	12
Evaluating tenders (Mid)	8.1	16.2	21.6	24.3	13.5	0.0	1.86	13
Pre-tender meeting (Mid)	10.8	18.9	29.7	18.9	10.8	0.0	1.78	14

Table 4 presents the frequencies at which architectural technologists consider / refer to construction ergonomics relative to sixteen design related aspects, in terms of a frequency range, never to always, and a MS ranging between 1.00 and 5.00. It is notable that only four (25%) of the sixteen MSs are above the midpoint of 3.00, which indicates consideration of / reference to H&S relative to these design related aspects can be deemed to be prevalent.

It is notable that no occasions fall within the range > 4.20 ≤ 5.00 – between often to always / always, and similarly within the range > 3.40 ≤ 4.20 – between sometimes to often / often. The top twelve (75%) occasions fall within the range > 2.60 ≤ 3.40 – between rarely to sometimes / sometimes.

Design (general) and plan layout predominate. It is notable that type of structural frame is ranked ninth as it is the stage that impacts most on construction ergonomics (Smallwood, 2002). Along with design (general) it provides the framework for a project in terms of construction ergonomics. Given that certain materials contain hazardous chemical substances it is notable that content of material achieved a ranking of thirteenth. Furthermore, given that materials handling, and more specifically the mass of materials contribute to manual materials handling, it is also notable that mass of materials has a MS below the midpoint of 3.00, and was ranked last. Similarly, given that the surface area of many materials required for certain elements such as gypsym boards for ceilings and partitions, and glazing for shop fronts is large, the MS of 2.41 is notable. However, it should be noted that schedule and finishes, which encapsulate materials and processes, achieved rankings of tenth and eleventh respectively.

Table 4. Frequency at which Architectural Technologists consider / refer to construction ergonomics relative to various design related aspects.

Aspect	Response (%)						Mean Score	Rank
	Unsure	Never	Rarely	Some-times	Often	Always		
Design (general)	0.0	8.1	8.1	24.3	56.8	2.7	3.38	1
Plan layout	0.0	2.7	10.8	24.3	56.8	2.7	3.38	2
Elevations	0.0	5.4	13.5	29.7	48.6	0.0	3.16	3
Method of fixing	0.0	10.8	16.2	32.4	40.5	0.0	3.03	4
Specification	0.0	8.3	13.9	36.1	38.9	0.0	3.00	5
Details	0.0	8.1	24.3	29.7	37.8	0.0	2.97	6
Position of components	0.0	8.1	16.2	35.1	37.8	0.0	2.97	7
Site location	2.7	8.1	18.9	24.3	40.5	2.7	2.95	8
Type of structural frame	0.0	2.7	24.3	51.4	21.6	0.0	2.92	9
Schedule	0.0	11.1	11.1	41.7	30.6	0.0	2.81	10
Finishes	2.7	10.8	21.6	37.8	24.3	0.0	2.65	11
Edge of materials	2.7	16.2	18.9	29.7	29.7	0.0	2.62	12
Content of material	0.0	16.2	16.2	43.2	18.9	0.0	2.54	13
Surface area of materials	0.0	13.5	27.0	32.4	18.9	0.0	2.41	14
Texture of materials	0.0	13.5	24.3	40.5	13.5	0.0	2.38	15
Mass of materials	2.7	8.1	51.4	27.0	10.8	0.0	2.35	16

Table 5 indicates the perceived impact of sixteen design related aspects on construction ergonomics, in terms of percentage responses to 'does not' and a scale of 1 (minor) to 5 (major), and a MS ranging between 0.00 and 5.00. Given that a 'does not' option was provided the scale effectively consists of six points, and hence the MS range. It is notable that all sixteen MSs are above the midpoint of 2.50, which indicates the respondents perceive the design related aspects to impact on construction ergonomics.

It is notable that no MSs fall within the range of > 4.17 ≤ 5.00 - between a near major to major impact / major impact. All sixteen aspects fall within the range > 3.34 ≤ 4.17, which indicates that they have between an impact and a near major impact / near major impact on construction ergonomics. Notable rankings include type of structural frame (seventh), finishes (eighth), method of fixing (ninth), mass of materials (twelfth), and surface area of materials (fifteenth), as these have a major effect in terms of manual handling.

Table 5. Extent to which various design related aspects impact on construction ergonomics.

Aspect	Response (%)							Mean Score	Rank
	Unsure	Does not	Minor…………………………..Major						
			1	2	3	4	5		
Site location	2.7	2.7	2.7	5.4	10.8	24.3	51.4	4.11	1
Design (general)	2.7	2.7	0.0	5.4	10.8	37.8	40.5	4.08	2
Plan layout	2.7	5.4	0.0	2.7	16.2	21.6	51.4	4.08	3
Details	0.0	0.0	2.7	2.7	18.9	37.8	37.8	4.05	4
Position of components	2.8	0.0	0.0	8.3	16.7	36.1	36.1	4.03	5
Edge of materials	8.1	0.0	2.7	8.1	21.6	18.9	40.5	3.94	6
Type of structural frame	2.7	0.0	2.7	10.8	16.2	32.4	35.1	3.89	7
Finishes	5.4	0.0	5.4	5.4	21.6	27.0	35.1	3.86	8
Method of fixing	2.7	0.0	8.1	8.1	16.2	24.3	40.5	3.83	9
Elevations	2.7	5.4	0.0	8.1	16.2	32.4	35.1	3.81	10
Specification	0.0	0.0	8.1	5.4	24.3	32.4	29.7	3.70	11
Mass of materials	8.1	0.0	8.1	8.1	13.5	40.5	21.6	3.65	12
Schedule	5.4	2.7	5.4	8.1	21.6	29.7	27.0	3.60	13
Texture of materials	2.7	0.0	8.1	10.8	24.3	27.0	27.0	3.56	14
Surface area of materials	5.4	2.7	10.8	10.8	18.9	18.9	32.4	3.46	15
Content of material	2.7	2.7	8.1	13.5	16.2	32.4	24.3	3.44	16

Respondents were requested to indicate their knowledge of ergonomics and 'designing for ergonomics' skills in terms of percentage responses to a scale of 1 (limited) to 5 (extensive), and a MS ranging between 1.00 and 5.00. Given that the MS (2.57) falls within the range > 1.80 ≤ 2.60 their knowledge can be deemed to be between limited to less than average / less than average. However, 2.57 falls marginally outside the upper range > 2.60 ≤ 3.40 – less than average to average / average. The 8.6% 'unsure' response is notable.

Experience (83.3%) predominates in terms of respondents' source of ergonomics knowledge. Tertiary education (43.2%) and magazine articles (40.5%) attracted the next highest levels of response. Tertiary education, practice notes (16.2%), postgraduate qualifications (10.8%), and CPD seminars (0%) are notable, as they directly relate to the discipline, profession, and practice of architectural technology.

Only 30.6% of respondents were aware of the provisions of Section 10 of the OH&S Act of 1993, 52.8% were not, and 16.7% were unsure. However, only 54.5% of those that were aware could communicate a synopsis of the content thereof. 25% of respondents were aware of the ergonomics related provisions of the Construction Regulations, 55.6% were not, and 19.4% were unsure. However, only 22.2% of those that were aware could communicate a synopsis of the content thereof.

Table 6 indicates the potential of various aspects / interventions to contribute to an improvement in construction ergonomics during the various project phases in terms of percentage responses to a scale of 1 (minor) to 5 (major), and a MS ranging between 1.00 and 5.00. The letters inserted within parentheses denote whether the aspect / intervention is construction (C), design (D), procurement (P), or multi-phase related. It is notable that all the MSs are above the midpoint of 3.00, which indicates that in general the respondents can be deemed to perceive the various aspects / interventions to have the potential to contribute to an improvement in construction ergonomics during the various project phases.

Safe working procedures, general design and awareness predominate and their MSs fall within the range > 4.20 ≤ 5.00 – between near major potential to major potential / major potential to contribute. The remaining aspects fall within the range > 3.40 ≤ 4.20 – between potential to near major potential / near major potential to contribute. It is notable that the top ranked aspect / intervention is construction phase related, the second design, the third, construction and design related, and that the fourth and fifth aspects / interventions, constructability (general) and general design, are design related.

Table 6. Potential of various aspects / interventions to contribute to an improvement in construction ergonomics during the various project phases.

Aspect / Intervention (C / D / P)	**Response (%)**						**Mean Score**	**Rank**
	Unsure	**Minor………………………………………………..Major**						
		1	**2**	**3**	**4**	**5**		
Safe working procedures (C)	2.7	2.7	0.0	10.8	21.6	62.2	4.44	1
General design (D)	0.0	0.0	0.0	13.5	32.4	54.1	4.41	2
Awareness (C & D)	2.7	0.0	5.4	8.1	35.1	48.6	4.31	3
Constructability (general) (D)	0.0	0.0	8.3	11.1	41.7	38.9	4.11	4
Details (D)	0.0	0.0	5.6	16.7	44.4	33.3	4.08	5
Contractor planning (C)	2.7	2.7	10.8	8.1	35.1	40.5	4.03	6
Design of construction equipment (C)	5.7	0.0	11.4	14.3	37.1	31.4	3.94	7
Specification (D)	2.8	5.6	5.6	19.4	33.3	33.3	3.86	8
Reengineering (C, D & P)	19.4	2.8	11.1	16.7	22.2	27.8	3.76	9
Design of tools (C)	5.6	0.0	19.4	13.9	36.1	25.0	3.71	10
Prefabrication (D)	0.0	2.8	11.1	27.8	33.3	25.0	3.67	11
Mechanisation (C & D)	11.1	2.8	16.7	13.9	30.6	25.0	3.66	12
Workshops on site (C)	0.0	8.3	11.1	16.7	36.1	27.8	3.64	13

5. Conclusions

The traditional project parameters of cost, quality, and time are more important than project H&S and construction ergonomics to architectural technologists, and in the case of quality, substantially so. Therefore it can be concluded that architectural technologists do not understand and appreciate the synergy between project H&S and ergonomics, and the other parameters.

Although, construction ergonomics is important, it is less important than ergonomics during the maintenance and commissioning phases and substantially less important than ergonomics during the use phase, and therefore the focus is likely to be more on the latter phases than the former phase.

Architectural technologists do consider construction ergonomics on various occasions, more so during upstream phases than mid-stream phases, concept design included. Therefore it can be concluded that the cited importance thereof does manifest itself. However, the frequency is equally between rarely to sometimes / sometimes, and to never to rarely / rarely.

Architectural practices consider construction ergonomics on various design related occasions. However, the frequency is mostly between rarely to sometimes / sometimes (75%), and between never to rarely / rarely (25%).

The frequency relative to mass of materials is notable and is possibly attributable to a lack of knowledge of the mass of materials.

Architectural technologists do appreciate the extent to which various design related aspects impact on construction ergonomics in that they maintain all design related aspects have between an impact to near major impact / near major impact.

It can be concluded that architectural technologists' source of knowledge is more informal than formal – experience vis-à-vis tertiary education. It can also be concluded that tertiary architectural technologist education and the architectural technologist profession are not addressing ergonomics to the extent that they should. These conclusions are reinforced by the architectural technologists' 'below average' self-rating of their knowledge of ergonomics and designing for ergonomics skills.

There is a low level of awareness relative to certain provisions of the OH&S Act and the Construction Regulations. Therefore, it can be concluded that tertiary architectural technologist education and the architectural technologist profession is not addressing ergonomics and construction to the extent that they should.

Architectural technologists do appreciate the potential of various design, procurement and construction practices to contribute to an improvement in construction ergonomics.

6. Recommendations

Tertiary architectural technologist education should address construction H&S and ergonomics, and highlight the role thereof in overall project performance. Furthermore, designing for construction H&S and ergonomics should be introduced in tertiary architectural technologist education programmes.

The South African Institute of Architectural Technologists (SAIAT) should evolve construction H&S and ergonomics practice notes and promote continuing professional development relative to construction H&S and ergonomics.

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